Nutrient Addition Experiments in a Nitrogen-Limited High Plains Reservoir Where Nitrogen-Fixing Algae Seldom Bloom

Matthew F. Knowlton and John R. Jones
School of Natural Resources
112 Stephens Hall, University of Missouri
Columbia, MO 65211

ABSTRACT

Cherry Creek Lake in Colorado is a shallow flood control reservoir that exhibits infrequent blooms of nitrogen-fixing cyanobacteria one of which occurred in summer 1992. In nutrient addition experiments run before and during the bloom, added nitrogen significantly stimulated algal growth. The magnitude of the N-effect was much greater in the pre-bloom experiments in which added phosphorus had no effect. During the bloom, added P had small but significant effects on growth indicating concurrent P and N limitation. Monitoring data suggest that phytoplankton is usually N-limited in the lake, but, for unknown reasons, blooms of N-fixing algae are rare.

INTRODUCTION

The ability of heterocystous cyanobacteria to fix atmospheric nitrogen means that phosphorus, rather than nitrogen, is likely to limit the total algal community biomass in a given freshwater system (Schindler 1977). For this reason, management of eutrophication has usually focused on phosphorus control (Hecky and Kilham 1988). But in some lakes with abundant P supplies, N-fixing cyanobacteria occur rarely and so N usually limits algal biomass (Howarth et al. 1988). This situation is both boon and bane to lake managers. On one hand, the preponderance of N-limitation will result in lower algal biomass, and hense, better water quality than predicted on the basis of phosphorus. Maximum, P-limited biomass will be observed only during rare blooms of N-fixers. On the other hand, the rarity of such blooms creates problems in justifying the expense of P-control measures needed to regulate these infrequent, but objectionable, maximum blooms.

Cherry Creek Lake, near Denver, Colorado, provides an example of this scenario. The lake and its catchment are subject to comprehensive regulations for control of phosphorus inputs. But lake monitoring data suggest that algal biomass is well below the threshold of P-limitation except during blooms of colonial cyanobacteria. In summer 1992, we conducted four *in situ* algal growth experiments to document the nutrient status of the phytoplankton community. This paper presents the results of these experiments together with an overview of nutrient-algal relations in this waterbody.

---

[a] Contribution from the Missouri Agricultural Experiment Station, Journal Series No. 12,339